White Paper

The ICTV Digital System

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ICTV Mission

ICTV Inc. supplies cable operators with highly advanced broadband communications systems for interactive television (iTV). The Company's digital iTV delivery platform provides cable operators with a headend-based solution that enables delivery of broadband Internet, email with attachments, and interactive TV applications to any digital set-top box (DSTB).

The ICTV solution enables a full range of iTV possibilities, and provides a consistent experience across any digital set-top box, including all current and future generation of boxes. Employing a patented frequency reuse model, the ICTV system is scalable on any two-way Hybrid Fiber Coaxial (HFC) cable system.

Applications

ICTV's system architecture features PC-based clients running Microsoft® Windows® and Microsoft Internet Explorer browser. This open, TV Browser solution gives content developers a standards-based development platform and increases the type and range of content and/or applications an MSO can offer cable subscribers. These include:

- **E-mail** — ICTV enables full-featured mail services designed specifically to afford a visually satisfying e-mail-on-TV experience. The ICTV platform supports SMTP, POP3 and IMAP4 and enables all the familiar functionality, including address book, attachments, multiple folders, multiple accounts and self-administration.
- **Walled Garden** — The ICTV platform supports a tightly controlled browsing environment of light content developed specifically for television. Such content could be developed using standard HTML, Java and JavaScript and delivered off of local servers or a private regional network not requiring Internet access.
- **Walled Jungle** — Should the MSO choose to extend a Walled Garden concept to include a richer, BroadbandTV experience, the ICTV platform supports advanced media streaming technologies that require plug-ins.
- **Fenced Prairie** — Extends the Walled Jungle concept beyond a proprietary network to content partners on the Web, while circumscribing access to a defined range of approved Web pages (URLs).
- **Broadband Internet Access** — The ICTV Digital System includes an internal multi-Gigabit-per-second backbone making it capable of providing cable subscribers with unrestricted, fast, high-bandwidth Internet access.

MSO Revenue Model

The ICTV infrastructure solutions provide MSOs with a range of new revenue generating opportunities. Beyond core service access fees, portal control offers MSOs additional revenue streams:

- **Slotting fees** — A TV Browser portal provides opportunities for generating tiered fees based on high-visibility, repetitive and/or highly targeted placement of advertising and content.
- **Targeted, rich media advertising** — Rich media, full-motion video/audio ads (including interactive ads), can be delivered to subscribers. These ads can be presented as banner ads at context-sensitive locations within the media portal and targeted to subscribers based on usage patterns.
- **E-commerce commissions** — ICTV supports e-commerce activity management at the headend. This provides MSOs opportunities to participate in transaction revenues.
- **Premium Services** — Additional fees are achievable by providing premium content and applications such as games, music videos and movie shorts and short form video on demand.

These revenue opportunities represent a sample of the broader revenue models associated with iTV. ICTV's infrastructure solutions are sufficiently flexible to accommodate a wide variety of additional applications and business models.

ICTV Solution

The ICTV system is a highly advanced broadband communications system for interactive television residing in the cable plant headend. The Company's digital iTV delivery platform provides cable operators with a solution that enables delivery of broadband Internet, email with attachments, and interactive TV applications to any digital set-top box (DSTB). It provides cable operators with interactive broadband services such as Web browsing, e-mail, and rich media streaming.

The top-level architecture is comprised of a System Manager (running Microsoft Windows NT®) and Session Processors (Intel®-based PC clients running under Microsoft Windows and hosting Microsoft Internet Explorer browser). The overall architecture is standard, open and scalable.

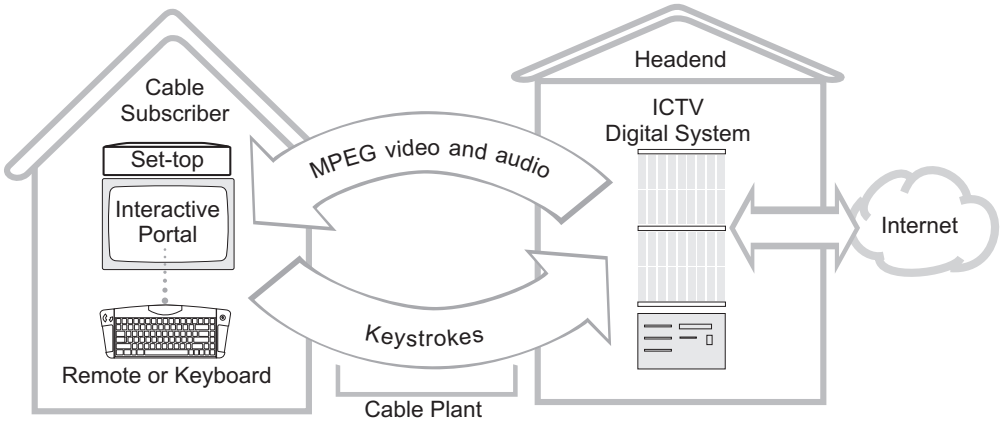

Figure 1: ICTV Solution

1. Using a remote device, the cable subscriber sends keystrokes to the ICTV System located in the headend.
2. Keystrokes are processed by an ICTV System PC client.
3. PC video and audio are encoded to MPEG-2 and Dolby® AC-3™ respectively then transmitted to the digital set-top.

The ICTV solution utilizes a combination of technologies to receive keystroke input from the subscriber in the home, converting IP video and audio to MPEG-2 and Dolby AC-3 output, and multiplexing several outputs into a single QAM stream. The QAM is upconverted to a 6MHz channel and transmitted to the subscriber's set-top. The video and audio are decoded and displayed on the television.

Scalability

By applying a patented ICTV cellularization technique, the ICTV System can reuse the same 6Mhz channel in each laser node (or combination of nodes). This technique multiplies the total number of simultaneous sessions achievable across the cable plant without requiring additional spectrum. For example, if the cable plant served 100 laser nodes, the ICTV platform could provide 600MHz of bandwidth (100 X 6MHz) by reusing the same 6MHz channel in each laser node.

ICTV's advantages

A critical distinguishing feature of the ICTV solution is the deployment of all processing-intensive resources in the cable plant headend rather than inside the set-top. This gives ICTV's solution the following direct and indirect advantages over set-top-centric solutions:

- **Plug-in support** — ICTV is the only iTV solution to offer a fully functional BroadbandTV browser. By utilizing Microsoft's Internet Explorer browser, ICTV can support all major plug-ins. A plug-in is a special software component running in the browser. It is required to play audio/video entertainment content developed for the Web — no plug-in means no access to "streaming" Web content.

  The ICTV System supports the following plug-ins: Flash™ 5, Shockwave® 8, DirectX® 6.1, RealPlayer® 6.09 (Version 8), QuickTime™ 4.1.1 and Windows Media Player™ 7. Additional plug-ins are made available on a regular basis.

  While it may be possible to equip the next generation of set-tops with plug-ins, keeping them updated will be a complex and risky proposition.

- **Lifecycle cost** — ICTV is able to minimize set-top obsolescence risks on two important fronts:

  First, the ICTV solution provides full broadband functionality to any digital set-top currently deployed, so there is no need to provision more advanced set-tops to offer full broadband interactive services.

  Second, because ICTV locates all processing-intensive software and hardware in the headend, upgrades can be made without the need to replace set-top boxes. This ensures that the consumer experience remains the same – no matter what generation of set-top is present.

- **Extensibility** — ICTV's open system approach is based on the leading, most commonly adopted standards in both the cable and computer industries. As a result, operators can have a high degree of confidence that the platform can be customized and extended to add new functionality and adapt to change.

- **Flexibility** — With the ICTV solution, the MSO has complete control over a customized approach to a wide range of service offerings, including: branding, portal user interface design, levels and types of services offered (e.g. e-mail, walled garden, broadband Internet), content partnerships and specialized television applications. ICTV's architecture support private networks and remote-content server integration.

- **Simplicity** — Standard, straightforward and simple, the ICTV System is built on a foundation of standard PC technology. ICTV employs a standard browser interface. PC video and audio are converted to standard MPEG and delivered to the subscriber's digital set-top box.

Technical Description

The ICTV Digital System is designed for Hybrid Fiber Coaxial (HFC) cable plants utilizing a fiber optic to node topology.

Figure 4 : Functional Block Diagram (located at the end of this section) illustrates the elemental components of the ICTV Digital System and how the system integrates into and communicates across the ITV topology of a cable plant.

Numbers 1-5 located on the Functional Block Diagram refer to the following numbered topics:

❶ **ICTV Digital System:** The shaded area on the diagram outlined with a dashed line contains the primary components of the system. System hardware occupies a standard 19" rack form factor comprised of a Microsoft Windows NT operating environment (System Management Server), Intel-based PC clients running under Microsoft Windows hosting Microsoft Internet Explorer browser, and a low-latency multiplexer. System components communicate via an internal multi-Gigabit-per-second backbone. This provides an overall architecture that is standard, open and scalable.

The ICTV **System Management Server** manages system processes involved in providing services to subscribers. System processes include: validating incoming requests for service, associating account information and user preferences with a request for service, provisioning PC client resources to host individual sessions, recording subscriber usage data, and continuously monitoring and logging of system activities.

Each **PC client** in the Digital System is capable of hosting multiple simultaneous subscriber sessions. Each "session" consists of a dedicated Windows operating environment and Internet Explorer browser. A session is allocated to a subscriber only while the subscriber is using the service. The PC client processes keystroke input from the subscriber (such as Web browsing and e-mail activities), encodes the PC video and audio to MPEG and Dolby AC-3 respectively then delivers the MPEG elementary stream to the Multiplexer.

The **Low Latency Multiplexer** receives the several video and audio elementary streams from each of the several PC clients assigned to it and creates a multiplexed transport stream. The transport stream is transmitted as QAM 64 or 256 (depending on cable plant requirements) and upconverted to a 6MHz RF channel output.

The dashed line on the diagram separating the Multiplexer from the rest of the ICTV system indicates flexibility in locating the multiplexer remotely. This will facilitate inserting the RF output at the appropriate forward laser.

❷ **Cable plant:** The system integration requirements for the ICTV Digital System into an HFC cable plant varies depending on several factors including specific cable plant infrastructure, existing digital services and the specific services the ICTV system will provide.

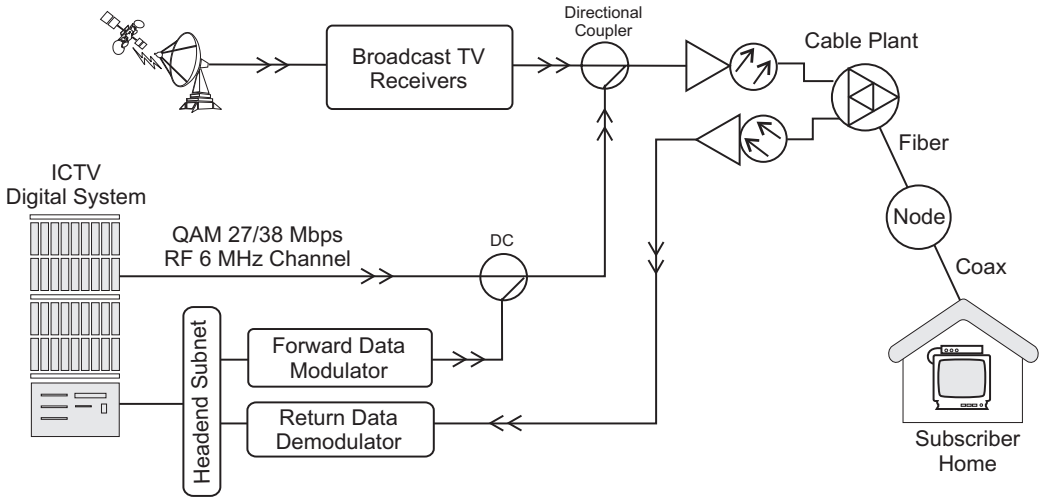

Figure 2: Cable plant integration

Figure 2: Cable plant integration illustrates a simplified view of signal flows and interfaces associated with the ICTV Digital System.

- ICTV System QAM output is upconverted to a 6 MHz channel, combined with the CATV channel line-up, and inserted at the forward laser.
- Keystrokes are transmitted from the digital set-top via the cable plant return path to the Return Data Demodulator located in the headend and then transferred to the ICTV System via Ethernet.
- Forward data from the ICTV System is conveyed via Ethernet to the Forward Data Modulator. Forward Data RF output is then combined with the ICTV System QAM RF signal.

❸ **Subscriber home:** As previously described, the ICTV Digital System delivers Broadband TV to any MPEG-based digital set-top. All that is required in the subscriber's home is an MPEG-based set-top, infrared remote control and/or infrared keyboard and a cable-ready television.

When the subscriber requests service by pressing a designated key on the remote device, the digital set-top sends a message via the cable return path to the ICTV System in the Headend. The ICTV System allocates PC resources to the subscriber and sends a virtual channel number to the set-top. The set-top tunes to the virtual channel and the interactive portal is displayed on the television. The interactive portal is entirely configurable by the cable operator.

Figure 3: Interactive portal sample

❹ **System administration applications:** Based on Sybase® database server technology, the ICTV System provides applications for managing system resources and subscriber information:

- **Network Management Client:** Designed to provide maximum insight and control over the ICTV platform. The application provides data and reporting presentation tools for the System Server, Multiplexer and Client PCs. The application can drill down to QAM utilization, Mbps transmitted over the Multiplexer, Multiplexer utilization, throughput statistics and session statistics. Data presentation is easily customized using a simple graphical user interface.
- **System Management Client:** Designed to give the operator insight into the architecture, integration, operation and configuration of the ICTV system. The System Management application indicates channel numbers and channel maps, physical hardware locations, hardware configuration tables and hardware assignment functionality. These tools provide highly flexible configuration control including configurable presentation layers and permission structures.
- **Provisioning Client:** Designed to allow the operator to manage customer data in a Customer Service Representative (CSR) application environment. The Provisioning application gives operators control over customer tables, users, user preferences, filtering options, history, asset management and monetary constraints. While much of this data is configurable by the customer in the home user interface, the provisioning client provides the operator with a simple, straightforward interface ensuring an optimized subscriber relationship management tool.

- **Billing Client:** The billing client is a complete stand-alone billing solution for the ICTV platform. The application provides standard billing functions such as aggregate and subscriber specific data on debits, credits, payments, billing, aging, promotional codes and programs. The system can currently export data to any major billing system and will integrate with most major MSO billing software packages by Q2 2001.

❺ **Remote Servers:** While the ICTV system provides complete standalone functionality, it is even more powerful when managing content access as an integral part of a larger system. Specifically, the ICTV system can support a variety of server applications that are either fed from the public Internet backbone or fed from virtual private networks (VPNs). Remote services can be provided in a variety of application configurations, however, several major elements are outlined below.

- **Remote Content Server:** Enables the operator to store content closer to the customer. This ensures a higher quality of service by reducing latency, ensuring uptime and allowing for greater control over content —critical for the deployment of walled garden services.
- **Advertising Server:** Enables the operator to serve a variety of advertisements to the television. Ads can be rich media streaming advertisements or banners. Either way, storing the content locally provides fault tolerance and ensures a higher quality of service.
- **E-mail server:** While ICTV enables a wide choice of e-mail solutions, network operators may already have relationships in place for supplying e-mail services. If so, the ICTV platform can easily integrate with third party e-mail providers.

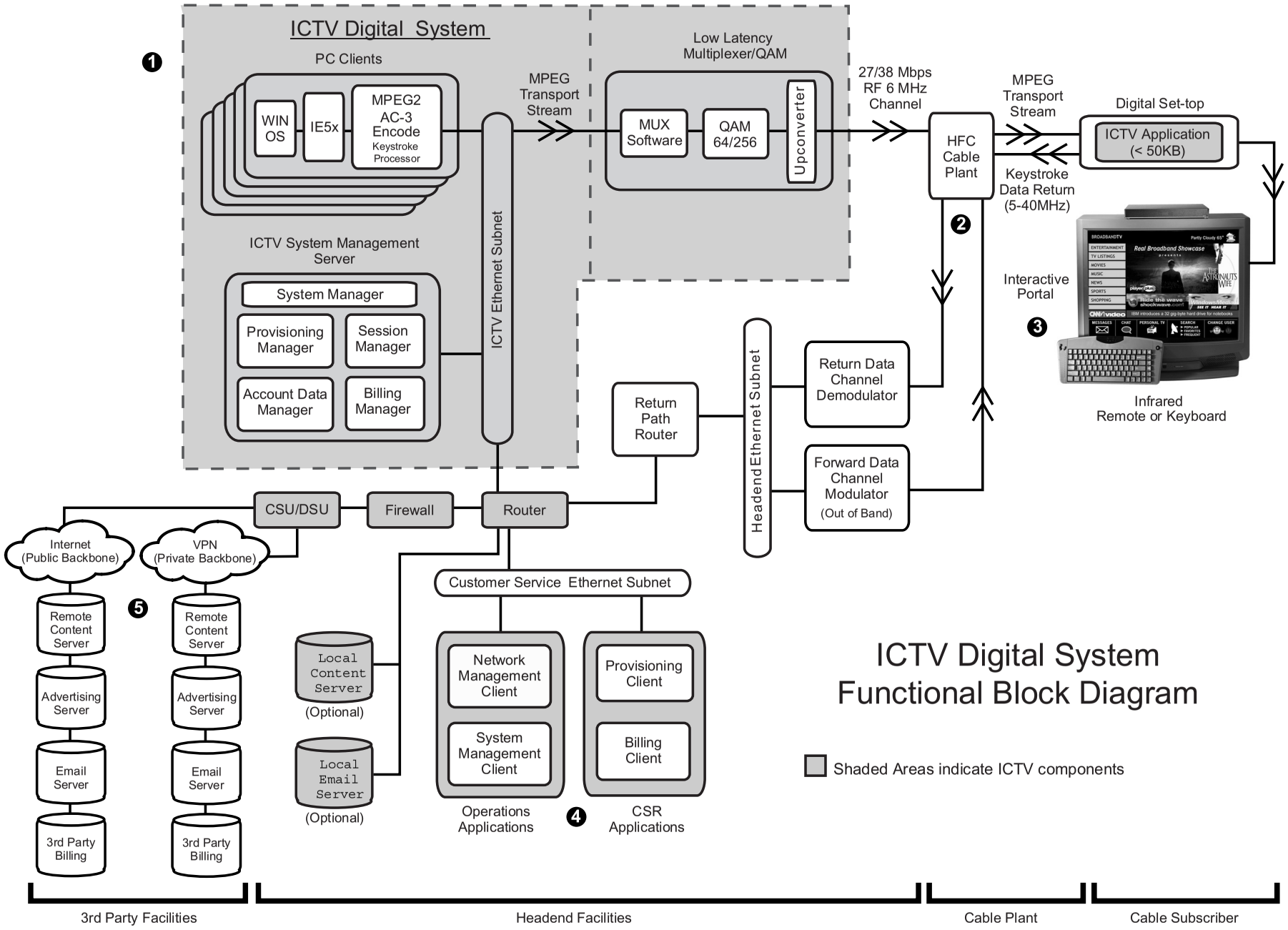

Figure 4 : Functional Block Diagram

About ICTV

Based in the heart of California's Silicon Valley, ICTV provides the cable industry's most robust solution for delivery of broadband Internet TV services to digital set tops. Strategic partners include industry leaders such as ACTV, Adelphia, Liberty Digital, Motorola, OpenTV, Shaw Communications, TV Guide, Cox and Lauder Partners. The company has been issued 21 patents and has 12 patents pending, ensuring protection of its unique and innovative solution. ICTV can be found on the World Wide Web at http://www.ictv.com.